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ABSTRACT

A study directed toward the education of preschool children is presented. This study, the Appalachia Preschool Education Program, was designed to affect the performance of children aged 3, 4, and 5 in four skill areas: orienting and attending, motor activity, language, and cognition. One of the instruments used in the evaluation of the program was the Peabody Picture Vocabulary Test (PPVT). Results of the administration of that test to children in the Preschool Education Program are presented. The report is divided into three sections. The first describes the test and its administration; the second presents the analysis of test data and compares the performance of children in three treatment groups and one control group. The third section explains and defends the use of post-test PPVT scores as a covariate in analyzing results of testing used in other instruments. (Author/CK)

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Analysis of Intelligence Scores

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Analysis of Intelligence Scores

Introduction

The Appalachia Preschool Education Program was designed to affect the performance of children aged 3, 4, and 5 in four skill areas: orienting and attending, motor activity, language, and cognition (Hooper and Marshall, 1968). One of the instruments used in the evaluation of the program was the Peabody Picture Vocabulary Test (PPVT). Results of administration of that test to children in the Preschool Education Program are presented in this report. The report is divided into three sections. The first describes the test and its administration, the second presents the analysis of test data and compares the performance of children in three treatment groups and one control group. The third section explains and defends the use of post-test PPVT scores as a covariate in analyzing results of testing using other instruments.

Description and Administration of the PPVT

The Peabody Picture Vocabulary Test consists of a series of 150 plates, each containing four illustrations. One of the four illustrations on each plate corresponds to a key word chosen from Webster's New Collegiate Dictionary (G. and C. Merriam Co., 1953).

In administering the test, the examiner begins at a level recommended in the manual for the age level of the youngster being tested. If the subject misses an item before correctly answering eight items in a row, the test administrator works backwards from the mistake and continues until eight consecutive correct responses are achieved by the child. The examiner pronounces a word from the list, while at the same time showing the child a plate containing the illustration of the word. The child responds by pointing to the picture corresponding to the word named. Following six incorrect

answers in eight responses, testing is discontinued. The total number of correct responses on all items is the raw score, and from that a mental age (M.A.) score is derived. In addition, raw score and chronological age are used to compute a deviation IQ score with a mean of 100 and a standard deviation of 15.

Age Comparisons

Children who were selected for the three treatment groups in the Preschool Education Program were assigned to an age classification on the basis of chronological age as of October 1. This procedure made it possible for children in one age group to differ by as much as one year, and even greater differences in average age in months among the groups were therefore possible. In order to take age differences into account in the analysis, it was necessary to compare children in the treatment groups on this factor.

Table 13.1 summarizes the data. The figures shown are mean age in months by sex and age classification for the three treatment and one control groups. The figure given is the mean age in months at the end of the third year of testing, so that children who had attained their third birthday prior to October 1 of the previous year had by this time passed their fourth birthdays. The control group, for example, averaged exactly 4 years of age, while the three treatment groups were all somewhat older.

Analysis of variance of these data (Table 13.2) showed that the groups differed significantly from one another in mean age in months. Subsequent analysis using Dunnett's procedure revealed that the TV only group was significantly older than the other three. The means for the four groups are illustrated in Figure 13.1.

Table 13.1

Mean Age in Months by Class, Treatment Group, and Sex

		TV-HV-MC	TV-HV	TV only	Control
3	M	$\bar{x}$= 50.67 N= 12 σ= 2.43	$\bar{x}$= 49.63 N= 16 σ= 3.14	$\bar{x}$= 52.75 N= 8 σ= 4.26	$\bar{x}$= 48.00 N= 17 σ= 4.06
	F	$\bar{x}$= 50.15 N= 13 σ= 2.21	$\bar{x}$= 48.94 N= 18 σ= 4.96	$\bar{x}$= 51.00 N= 5 σ= 3.29	$\bar{x}$= 48.53 N= 19 σ= 4.32
4	M	$\bar{x}$= 61.35 N= 20 σ= 3.48	$\bar{x}$= 62.36 N= 25 σ= 3.05	$\bar{x}$= 62.79 N= 14 σ= 5.82	$\bar{x}$= 59.11 N= 19 σ= 4.83
	F	$\bar{x}$= 62.00 N= 19 σ= 4.03	$\bar{x}$= 56.52 N= 23 σ= 4.70	$\bar{x}$= 60.75 N= 8 σ= 3.96	$\bar{x}$= 58.40 N= 20 σ= 4.54
5	M	$\bar{x}$= 73.13 N= 16 σ= 4.03	$\bar{x}$= 72.37 N= 27 σ= 4.12	$\bar{x}$= 73.17 N= 12 σ= 4.65	$\bar{x}$= 71.17 N= 18 σ= 4.92
	F	$\bar{x}$= 73.33 N= 15 σ= 5.72	$\bar{x}$= 71.27 N= 22 σ= 5.22	$\bar{x}$= 71.37 N= 19 σ= 6.34	$\bar{x}$= 71.13 N= 16 σ= 3.73
Total		$\bar{x}$= 62.47 N= 95 σ= 3.88	$\bar{x}$= 61.49 N= 131 σ= 4.28	$\bar{x}$= 64.68 N= 66 σ= 4.00	$\bar{x}$= 59.00 N= 109 σ= 4.43

(3)

Table 13.2

Summary of Analysis of Variance of Age in Months

Source	η^2	d.f.	Mean Square	F	p
Trt.	.074	3	40827.10	11.96	<.005
Sex	.003	1	6255.84	1.83	--
Age	.084	2	70039.71	20.51	<.005
Trt. by Sex	.006	3	3445.05	1.01	--
Trt. by Age	.028	6	7827.01	2.29	--
Sex by Age	.003	2	2592.60	0.76	--
Trt. by Sex by Age	.016	6	4426.75	1.30	--
Error	.782	378	3414.60		

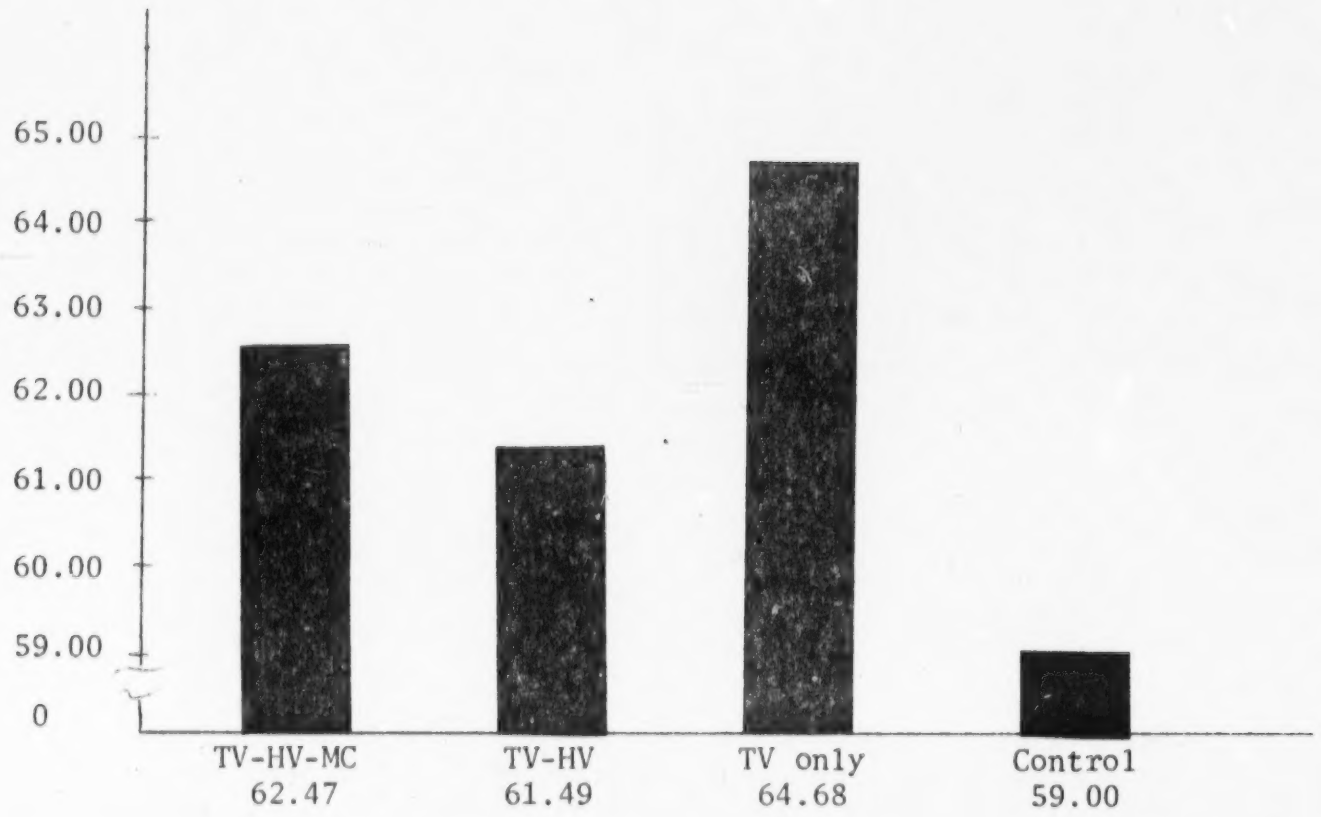

Figure 13.1

Mean Age in Months by Treatment Group

(4)

Analysis of Results

In June, 1970--at the end of the second year of the field test of the Preschool Education Program--the PPVT was administered to a randomly selected sample of 168 4- and 5-year-old children in three treatment and one control groups. The treatment groups were:

- Those receiving three components of the program--television, home visitors, and mobile classroom (TV-HV-MC).
- Those receiving only the first two components (TV-HV).
- Those receiving television only (TV only).

The control group consisted of children of similar backgrounds from another region in the state. The PPVT was administered in September, 1970, to 74 3-year-old children who were entering the program for the first time. These test results, on a total of 242 children, are reported in Table 13.3 as pretest scores. Tests administered in June, 1971, to 396 children--all who were then in the program--are shown in that table as post-test results. The analyses which follow are based on the data contained in Table 13.3.

Analysis of variance on the post-test PPVT scores showed significant treatment effects (Table 13.4). The differences were attributable to the higher mean for the TV-HV-MC group as shown by post hoc comparisons using Dunnett's test. Group means on the PPVT post-test are illustrated in Figure 13.2. Similar results were observed at the end of the second year of the field test of the program, so that to some extent the present findings are the result of carryover effects from the first two years of the program. They also may be attributable to preexisting differences in the skills which are measured by the PPVT. To control for both factors--cumulative effects and preexisting differences--it is necessary to examine a group of children for whom pretreatment test data are available and who have been in the program for only one year. The 3-year-old group fits that description, and what follows is an analysis of the performance on pretest and post-test PPVT by that group of children.

Table 13.5 shows the relative position of each of eight 3-year-old treatment by sex groups on the PPVT pretest. The data are taken directly from Table 13.3.

When comparisons are made on post-test and gain scores, some interesting patterns emerge. These data (Table 13.6) show that the control groups achieved the smallest gains among the eight groups. Male controls registered a gain score of 2.40, and the females increased their score by 3.70 from pretest to post-test. By comparison, the smallest treatment group gain score was 6.87 for male TV only and the largest was 19.30 for males in the TV-HV-MC group. In spite of the fact that the two control groups started

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Table 13.3

Pre and Post-test PPVT Raw Score Means, Standard Deviations, and Number of Subjects by Age, Sex, and Treatment

Age	Sex	TV-HV-MC		TV-HV		TV only		Control	
		Pretest	Post-test	Pretest	Post-test	Pretest	Post-test	Pretest	Post-test
3	M	$\bar{x}$= 26.20 N= 10 σ= 9.17	$\bar{x}$= 45.50 N= 12 σ= 7.95	$\bar{x}$= 28.00 N= 11 σ= 7.70	$\bar{x}$= 43.56 N= 16 σ= 10.83	$\bar{x}$= 31.63 N= 11 σ= 11.10	$\bar{x}$= 38.50 N= 8 σ= 6.73	$\bar{x}$= 36.13 N= 8 σ= 8.07	$\bar{x}$= 38.53 N= 17 σ= 9.95
	F	$\bar{x}$= 35.18 N= 11 σ= 9.77	$\bar{x}$= 44.54 N= 13 σ= 6.44	$\bar{x}$= 28.40 N= 10 σ= 10.32	$\bar{x}$= 39.29 N= 18 σ= 11.16	$\bar{x}$= 28.60 N= 5 σ= 5.43	$\bar{x}$= 37.40 N= 5 σ= 3.61	$\bar{x}$= 32.25 N= 8 σ= 9.69	$\bar{x}$= 35.95 N= 19 σ= 10.63
4	M	$\bar{x}$= 42.63 N= 9 σ= 6.55	$\bar{x}$= 54.50 N= 20 σ= 7.77	$\bar{x}$= 38.56 N= 9 σ= 13.33	$\bar{x}$= 50.00 N= 25 σ= 11.42	$\bar{x}$= 40.46 N= 13 σ= 11.60	$\bar{x}$= 52.79 N= 14 σ= 10.93	$\bar{x}$= 42.23 N= 13 σ= 10.51	$\bar{x}$= 48.82 N= 17 σ= 9.36
	F	$\bar{x}$= 42.63 N= 9 σ= 9.88	$\bar{x}$= 52.37 N= 19 σ= 8.82	$\bar{x}$= 42.80 N= 10 σ= 8.05	$\bar{x}$= 51.86 N= 22 σ= 9.41	$\bar{x}$= 32.90 N= 10 σ= 14.05	$\bar{x}$= 40.88 N= 8 σ= 13.80	$\bar{x}$= 37.31 N= 13 σ= 7.72	$\bar{x}$= 44.42 N= 19 σ= 6.54
5	M	$\bar{x}$= 50.38 N= 13 σ= 8.23	$\bar{x}$= 61.38 N= 16 σ= 8.75	$\bar{x}$= 51.13 N= 8 σ= 6.22	$\bar{x}$= 59.19 N= 27 σ= 5.81	$\bar{x}$= 39.88 N= 8 σ= 18.16	$\bar{x}$= 53.83 N= 12 σ= 13.02	$\bar{x}$= 45.89 N= 9 σ= 8.37	$\bar{x}$= 55.50 N= 18 σ= 4.87
	F	$\bar{x}$= 47.09 N= 11 σ= 9.43	$\bar{x}$= 52.73 N= 15 σ= 6.48	$\bar{x}$= 48.10 N= 10 σ= 10.35	$\bar{x}$= 56.00 N= 22 σ= 7.83	$\bar{x}$= 44.31 N= 13 σ= 11.95	$\bar{x}$= 54.53 N= 19 σ= 5.99	$\bar{x}$= 49.70 N= 10 σ= 6.88	$\bar{x}$= 54.20 N= 15 σ= 8.95
TOTAL		$\bar{x}$= 41.09 N= 63 σ= 8.92	$\bar{x}$= 52.45 N= 95 σ= 7.84	$\bar{x}$= 38.91 N= 58 σ= 9.59	$\bar{x}$= 50.96 N=130 σ= 9.44	$\bar{x}$= 37.35 N= 60 σ= 12.70	$\bar{x}$= 49.14 N= 66 σ= 9.80	$\bar{x}$= 40.83 N= 61 σ= 8.67	$\bar{x}$= 45.94 N=105 σ= 8.60

Table 13.4

Analysis of Variance Summary Table on PPVT Post-test Scores

Source	η^2	d.f.	Mean Square	F	p
Trt.	.080	3	30860.77	13.68	<.005
Sex	.006	1	7193.52	3.19	--
Age	.072	2	39125.51	17.35	<.005
Trt. by Sex	.006	3	2178.56	0.97	--
Trt. by Age	.030	6	5525.13	2.45	--
Sex by Age	.002	2	1313.31	0.58	--
Trt. by Sex by Age	.020	6	3673.96	1.63	--
Error	.770	373	2255.26		

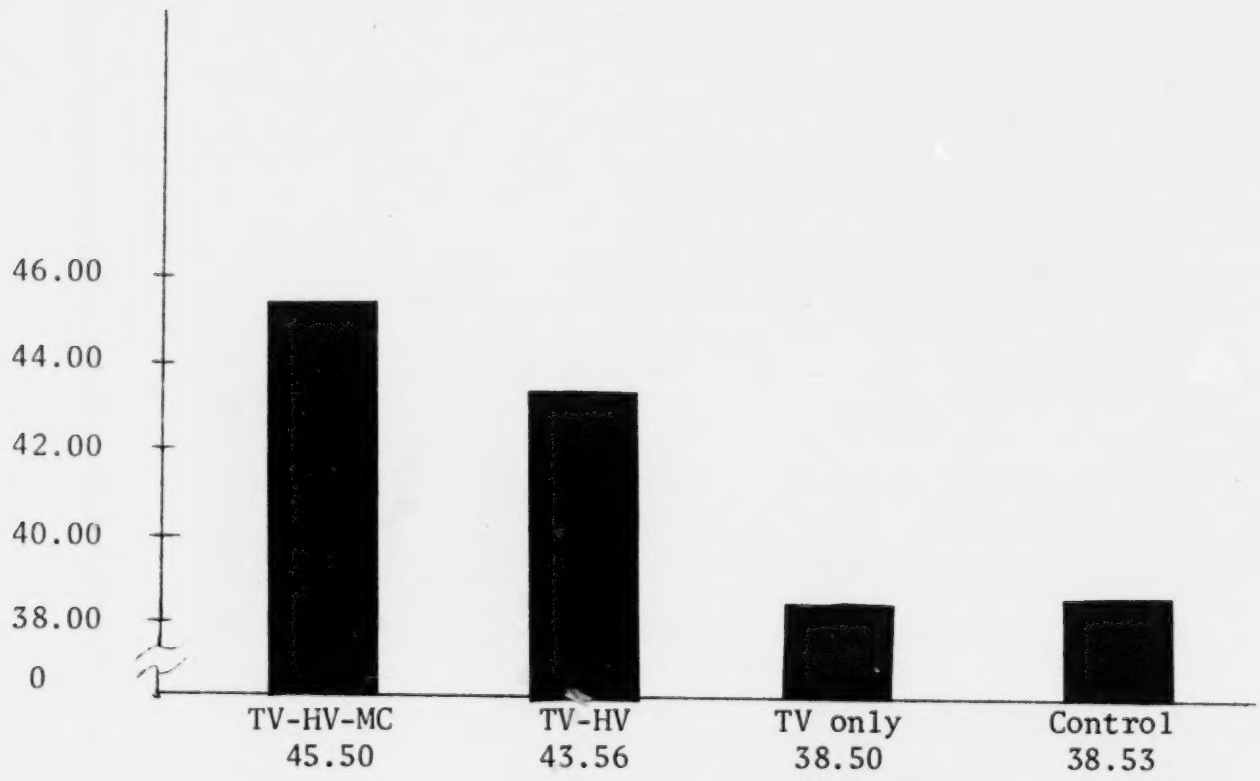

Figure 13.2

PPVT 3-Year-Old Post-test Means by Treatment

(7)

Table 13.5

PPVT Pretest Means for 3-Year-Olds
Ordered from High to Low

Group		Mean
Male	Control	36.13
Female	TV-HV-MC	35.18
Female	Control	32.25
Male	TV only	31.63
Female	TV only	28.60
Female	TV-HV	28.40
Male	TV-HV	28.00
Male	TV-HV-MC	26.20

Table 13.6

PPVT Post-test Means and Gain Scores for
3-Year-Olds Ordered by Pretest Rank

Pretest Rank	Group	Post-test	Gain Score
1	Male Control	38.53	2.40
2	Female TV-HV-MC	44.54	9.36
3	Female Control	35.95	3.70
4	Male TV only	38.50	6.87
5	Female TV only	37.40	8.80
6	Female TV-HV	38.29	9.89
7	Male TV-HV	43.56	15.56
8	Male TV-HV-MC	45.50	19.30

Table 13.7

PPVT IQ Score Means, Standard Deviations, Number of Subjects by Age, Sex, and Treatments for both Pre and Post-tests

Age	Sex	TV-HV-MC		TV-HV		TV only		Control	
		Pretest	Post-test	Pretest	Post-test	Pretest	Post-test	Pretest	Post-test
3	M	$\bar{x}$= 84.33 N= 10 σ= 17.06	$\bar{x}$= 104.00 N= 12 σ= 13.56	$\bar{x}$= 88.81 N= 11 σ= 10.65	$\bar{x}$= 101.63 N= 16 σ= 18.07	$\bar{x}$= 93.00 N= 11 σ= 19.84	$\bar{x}$= 88.50 N= 8 σ= 14.00	$\bar{x}$= 104.13 N= 8 σ= 15.10	$\bar{x}$= 96.29 N= 17 σ= 13.65
	F	$\bar{x}$= 99.81 N= 11 σ= 15.27	$\bar{x}$= 102.85 N= 13 σ= 13.28	$\bar{x}$= 87.10 N= 10 σ= 18.92	$\bar{x}$= 95.47 N= 17 σ= 20.95	$\bar{x}$= 84.40 N= 5 σ= 13.09	$\bar{x}$= 88.60 N= 5 σ= 6.15	$\bar{x}$= 95.75 N= 8 σ= 16.51	$\bar{x}$= 90.21 N= 19 σ= 16.20
4	M	$\bar{x}$= 97.63 N= 9 σ= 9.40	$\bar{x}$= 109.35 N= 20 σ= 12.97	$\bar{x}$= 93.44 N= 9 σ= 20.97	$\bar{x}$= 99.24 N= 25 σ= 20.76	$\bar{x}$= 94.85 N= 13 σ= 20.17	$\bar{x}$= 104.00 N= 14 σ= 20.04	$\bar{x}$= 96.69 N= 13 σ= 15.02	$\bar{x}$= 100.88 N= 17 σ= 18.94
	F	$\bar{x}$= 101.63 N= 9 σ= 14.25	$\bar{x}$= 103.63 N= 19 σ= 15.88	$\bar{x}$= 101.30 N= 10 σ= 14.79	$\bar{x}$= 104.59 N= 22 σ= 17.78	$\bar{x}$= 83.70 N= 10 σ= 19.86	$\bar{x}$= 87.63 N= 8 σ= 19.61	$\bar{x}$= 87.46 N= 13 σ= 15.89	$\bar{x}$= 94.53 N= 19 σ= 12.61
5	M	$\bar{x}$= 99.38 N= 13 σ= 12.20	$\bar{x}$= 112.25 N= 16 σ= 16.23	$\bar{x}$= 102.50 N= 8 σ= 8.11	$\bar{x}$= 107.15 N= 27 σ= 12.53	$\bar{x}$= 88.63 N= 8 σ= 23.08	$\bar{x}$= 101.17 N= 12 σ= 19.61	$\bar{x}$= 92.33 N= 9 σ= 15.78	$\bar{x}$= 100.50 N= 18 σ= 10.40
	F	$\bar{x}$= 94.82 N= 11 σ= 17.32	$\bar{x}$= 92.87 N= 15 σ= 13.99	$\bar{x}$= 95.30 N= 10 σ= 16.67	$\bar{x}$= 102.45 N= 22 σ= 15.00	$\bar{x}$= 88.38 N= 13 σ= 32.73	$\bar{x}$= 98.89 N= 19 σ= 14.10	$\bar{x}$= 93.90 N= 10 σ= 16.24	$\bar{x}$= 98.33 N= 15 σ= 19.69
TOTAL		$\bar{x}$= 96.34 N= 63 σ= 14.55	$\bar{x}$= 104.53 N= 95 σ= 14.44	$\bar{x}$= 94.53 N= 58 σ= 15.69	$\bar{x}$= 102.16 N= 130 σ= 17.52	$\bar{x}$= 89.55 N= 60 σ= 23.31	$\bar{x}$= 79.61 N= 66 σ= 16.90	$\bar{x}$= 94.47 N= 61 σ= 15.73	$\bar{x}$= 96.63 N= 105 σ= 15.44

out high in relation to the treatment groups, by the end of the year they had fallen behind. Spearman's rho applied to ranks for the eight groups on pretest and post-test results failed to indicate significance (r=-.24). However, the trend revealed by these comparisons is clear.

The PPVT IQ is a derived score based on a youngster's raw score on the test and his chronological age. Utilizing a table provided by the test publisher, the tester selects a point corresponding to the youngster's chronological age and raw score. This yields an IQ figure which is deviation in nature and allows the student's performance to be compared with that of his peers. Both pre and post-test mean IQ scores for each age by sex subgroup for the three treatment and one control groups are reported in Table 13.7. These means are depicted graphically in Figure 13.3. Since these IQ scores are by normed mean for each age (norm=100), no representation of the normative group is necessary.

Analysis of variance of the IQ scores computed using PPVT post-test results is shown in Table 13.8. Treatment effects were significant.

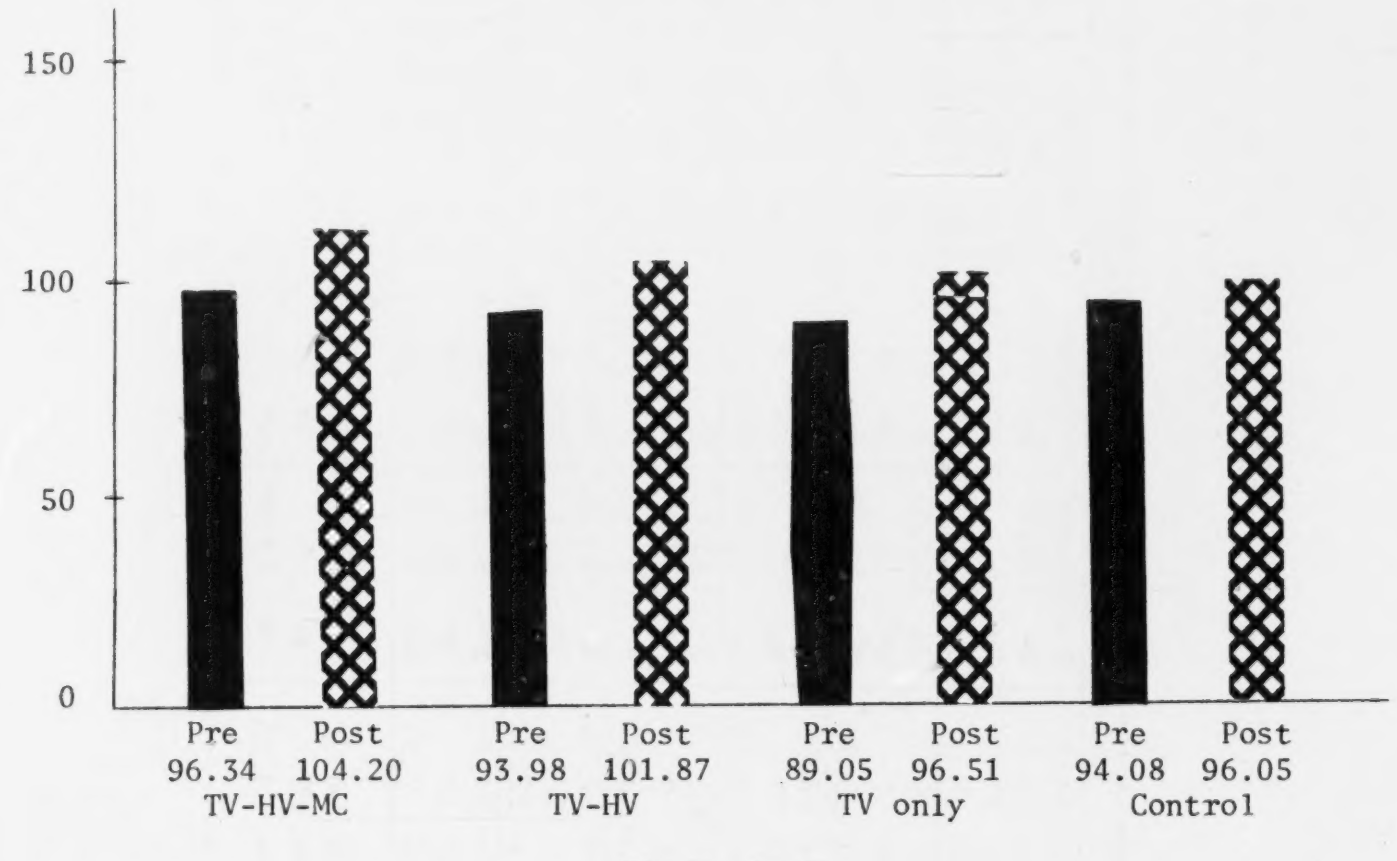

Figure 13.3

PPVT Pretest and Post-test IQ Scores by Treatment

(10)

Table 13.8

Analysis of Variance of PPVT Post-test IQ

Source	η^2	d.f.	Mean Square	F	p
Trt.	.08	3	136409.16	13.00	<.05
Sex	.003	1	18211.56	1.74	--
Age	.03	2	89270.90	8.51	<.05
Trt. by Sex	.007	3	12018.22	1.15	--
Trt. by Age	.02	6	23278.77	2.22	--
Sex by Age	.004	2	9607.99	0.92	--
Trt. by Sex by Age	.01	6	13236.92	1.26	--
Error		373	10489.04		

Use of PPVT Post-test Scores as Covariates

An important consideration in the evaluation of an effort such as the Preschool Education Program is the need to control for factors which are likely to influence treatment effects. Earlier discussion in this report dealt with the problem of age differences among treatment groups. Similar consideration must be given to uncontrolled variations in ability. Although the selection procedures involved in choosing children to participate in the Preschool Education Program were designed to minimize the possibility of systematic bias favoring one group over others, the possibility remained that sampling variations were large enough to distort the results of the evaluation.

Since there was no satisfactory pretest data available on all subjects involved in the program, the question was whether to ignore the problem altogether or rely on some less satisfactory means of controlling for this variation. The decision was to use PPVT post-test scores (as shown in Table 13.3) as one covariate in analysis of covariance of scores on the Illinois Test of Psycholinguistic Ability, the Frostig Test of Visual Perception, and the Appalachia Preschool Test. The other covariate was age in months.

The disadvantages of using a PPVT post-test score are, of course, immediately apparent. Scores were taken at the end of the third year of the field test and were not immune to treatment effects, as has been shown in analyses presented in this report. However, the PPVT was the one instrument which had been administered throughout the duration of the program which yielded an IQ score, and it was therefore the logical measure for use in covariance analysis.

The use of the PPVT post-test as a covariate is a conservative procedure. If it biases results, it does so in a direction which diminishes the likelihood that program treatment effects will appear significant.